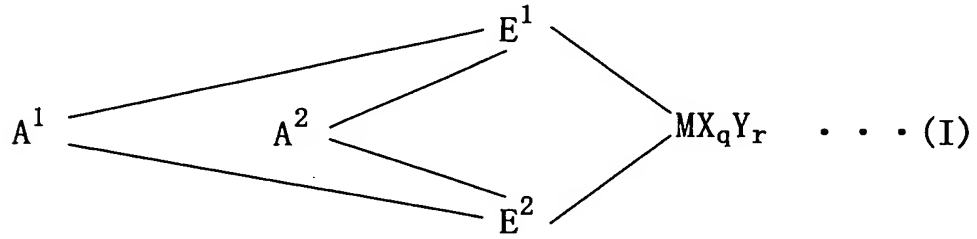
WHAT IS CLAIMED IS:

1. A process for producing a highly flowable propylene-based polymer, comprising:

polymerizing propylene in the presence of a polymerization catalyst comprising:

(A) a transition metal compound represented by the following general formula (I):



$$\cdots (I)$$

wherein M is a metal element belonging to Groups 3 to 10 or lanthanoid of the Period Table;

E^1 and E^2 are independently a ligand selected from the group consisting of substituted cyclopentadienyl, indenyl, substituted indenyl, heterocyclopentadienyl, substituted heterocyclopentadienyl, amide group, phosphide group, hydrocarbon groups and silicon-containing groups, which form a cross-linked structure via A^1 and A^2 and may be same or different from each other;

X is a ligand capable of forming a σ-bond with the proviso that when a plurality of X groups are present, these X groups may be same or different from each other, and may be cross-linked with the other X group, E^1, E^2 or Y;

Y is a Lewis base with the proviso that when a plurality of Y groups are present, these Y groups may be same or different from each other, and may be cross-linked with the other Y group, E^1, E^2 or X;

A^1 and A^2 are divalent cross-linking groups capable of bonding the two ligands E^1 and E^2 to each other which may be same or different from each other, and are independently a C_1 to C_{20} hydrocarbon group, a C_1 to C_{20} halogen-containing hydrocarbon group, a silicon-containing group, a germanium-containing group, a tin-containing group, -O-, -CO-, -S-, $-SO_2-$, -Se-, $-NR^1-$, $-PR^1-$, $-P(O)R^1-$, $-BR^1-$ or $-AlR^1-$ wherein R^1 is a hydrogen atom, a

halogen atom, a C_1 to C_{20} hydrocarbon group or a C_1 to C_{20} halogen-containing hydrocarbon group;

q is an integer of 1 to 5 given by the formula: [(valence of M) - 2]; and

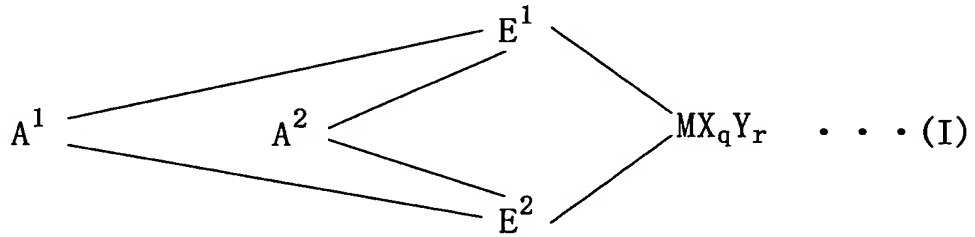
r is an integer of 0 to 3, and

(B) an organoboron compound.

2. A process for producing a highly flowable propylene-based polymer, comprising:

copolymerizing propylene with ethylene and/or a C_4 to C_{20} α-olefin in the presence of a polymerization catalyst comprising:

(A) a transition metal compound represented by the following general formula (I):



• • • (I)

wherein M is a metal element belonging to Groups 3 to 10 or lanthanoid of the Period Table;

E^1 and E^2 are independently a ligand selected from the group consisting of substituted cyclopentadienyl, indenyl, substituted indenyl, heterocyclopentadienyl, substituted heterocyclopentadienyl, amide group, phosphide group, hydrocarbon groups and silicon-containing groups, which form a cross-linked structure via A^1 and A^2 and may be same or different from each other;

X is a ligand capable of forming a σ-bond with the proviso that when a plurality of X groups are present, these X groups may be same or different from each other, and may be cross-linked with the other X group, E^1, E^2 or Y;

Y is a Lewis base with the proviso that when a plurality of Y groups are present, these Y groups may be same or different from each other, and may be cross-linked with the other Y group, E^1, E^2 or X;

A^1 and A^2 are divalent cross-linking groups capable of bonding the two ligands E^1 and E^2 to each other which may be same or different from each other, and are independently a C_1 to C_{20} hydrocarbon group, a C_1 to C_{20} halogen-containing hydrocarbon group, a silicon-containing group, a germanium-containing group, a tin-containing group, -O-, -CO-, -S-, $-SO_2-$, -Se-, $-NR^1-$, $-PR^1-$, $-P(O)R^1-$, $-BR^1-$ or $-AlR^1-$ wherein R^1 is a hydrogen atom, a halogen atom, a C_1 to C_{20} hydrocarbon group or a C_1 to C_{20} halogen-containing hydrocarbon group;

q is an integer of 1 to 5 given by the formula: [(valence of M) - 2]; and

r is an integer of 0 to 3, and

(B) an organoboron compound.

3. A highly flowable propylene-based polymer satisfying the following requirements (1), (2) and (3):

(1) an intrinsic viscosity [η] of 0.01 to 0.5 dL/g as measured in a tetralin solvent at 135°C;

(2) a crystalline resin having a melting point (Tm -D) of 0 to 120°C, the melting point being defined as a top of a peak observed on a highest-temperature side in a melting endothermic curve obtained by a differential scanning calorimeter (DSC) when a sample is held in a nitrogen atmosphere at -10°C for 5 min and then heated at a temperature rise rate of 10°C/min; and

(3) a stereoregularity index ([mm]) of 50 to 90 mol%.

4. A highly flowable propylene-based polymer according to claim 3, satisfying the following requirements (1'), (2') and (3'):

(1') an intrinsic viscosity [η] of 0.1 to 0.4 dL/g as measured in a tetralin solvent at 135°C;

(2') a crystalline resin having a melting point (Tm -D) of 60 to 120°C, the melting point being defined as a top of a peak observed on a highest-temperature side in a melting endothermic curve obtained by a

differential scanning calorimeter (DSC) when a sample is held in a nitrogen atmosphere at -10°C for 5 min and then heated at a temperature rise rate of 10°C/min; and

(3') a mesopentad fraction (mmmm) of 30 to 60 mol%.

5. The highly flowable propylene-based polymer according to claim 3 or 4, wherein said polymer further satisfies the following requirements (4) and (5):

(4) a molecular weight distribution (Mw/Mn) of 4 or lower as measured by gel permeation chromatography (GPC); and

(5) a weight-average molecular weigh of 10,000 to 100,000 as measured by GPC.

6. A propylene-based modifier comprising the highly flowable propylene-based polymer as claimed in claim 3.

7. A hot-melt adhesive composition comprising 99 to 50% by weight of the highly flowable propylene-based polymer as claimed in claim 3 or 4, and 50 to 1% by weight of a tackifier.